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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6: F16C 35/077 — A1

(11) International Publication Number: WO 95/23927

(43) International Publication Date: 8 September 1995 (08.09.95)

(21) International Application Number: PCT/AU95/00091

(22) International Filing Date: 27 February 1995 (27.02.95)

(30) Priority Data:
PM 4195 2 March 1994 (02.03.94) AU

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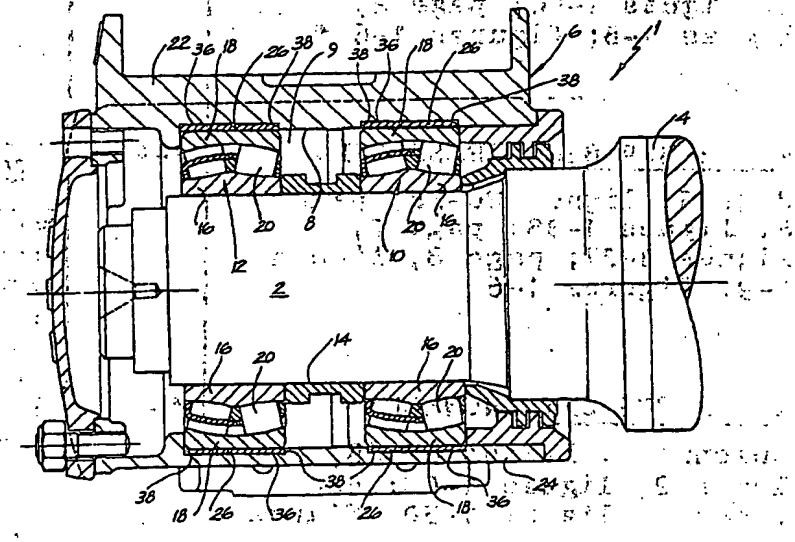
(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.

(54) Title: BEARING REFURBISHMENT



(57) Abstract

An outer race support sleeve (26) is disclosed for supporting the outer race (18) of a ball- or roller-bearing (10, 12) within a bearing housing (6) defining an inner cylindrical bearing surface (8), wherein the support sleeve (26) is annular and defines first and second circular edges (28, 30), is dimensioned so that its width, measured between the first and second circular edges (28, 30), is substantially equal to or not substantially greater than the width of the outer race (18) with which the support sleeve (26) is adapted to be used, and is split from the first circular edge (28) to the second circular edge (30) so as to define two adjacent end portions (34) of the support sleeve (26), the split (32) allowing the support sleeve (26) to be resiliently compressed, in use, so that said two adjacent end portions (34) overlap one another in order to reduce the effective diameter of the support sleeve (26), thus allowing the support sleeve (26) to be inserted into the bearing housing (6).

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Bearing Refurbishment

Field of the Invention

The invention relates to bearings, and particularly, although not exclusively, to bearings for axles of railway carriages.

Background of the Invention

It is known to support the axles of railway carriages by locating the ends of the axles in bearing housings, commonly known as axle boxes. An axle box has an inner cylindrical bearing surface defining an axle cavity within the axle box which is adapted to receive one end of an axle. The axle is mounted within the axle cavity by means of two roller- or ball-bearings which are arranged side by side, and spaced apart from one another in the direction of the axle. In the case of roller-bearings, each roller-bearing comprises an inner race, an outer race, and a number of rollers held between the two races. For ball bearings there is an inner race, an outer race and a number of balls held therebetween. The two bearings support the end of the axle, and allow it to rotate within the axle box.

It is normal practice for the inner race to be tightly fitted around the outer cylindrical surface of the axle, and for the outer race to be loosely fitted within the inner cylindrical bearing surface of the axle box. When the axle rotates most of the rotation is taken up by the rollers or balls themselves within the bearings. However, because the outer race is of slightly loose fit, it is also possible for the outer race to rotate within the axle box, albeit at a much slower rate than the axle itself.

Over a period of time, rotation of the outer race causes wear to the inner cylindrical bearing surface of the axle box. Rotation of the outer races causes annular grooves to be worn in the bearing surface. As the wear increases, the outer race becomes more and more loosely fitted within the axle box, until a point is reached at which the axle box is no longer safe for use. It is normal practice to inspect axle boxes for wear, and when an axle box is found to have a degree of wear which is no longer acceptable, to discard the axle box and replace it by a new axle box.

In order to avoid the need to discard a worn axle box, a number of different procedures have been proposed. In one such procedure, a skilled welder is required to fill the annular grooves worn in the bearing surface of the axle box by the outer races. The bearing surface is then machined so as to form a smooth, flush and level cylindrical surface. This method suffers from the disadvantage that the results obtained are highly dependent on the skill and expertise of the operator. Furthermore, the method is labour intensive, and thus costly to carry out. Alternative procedures involve filling the annular grooves worn by the outer races by means of electroplating, chrome plating, metal spraying or electrochemical deposition. Such methods are also labour intensive and costly.

As an alternative to filling the annular grooves worn by the outer races, it is know to machine down the whole of the inner cylindrical bearing surface until it is smooth and level, and then to insert a metal sleeve into the axle cavity in order to support the roller-bearings against the axle. This method also suffers from a number of disadvantages. In particular, a large amount of machining is required in order to level the bearing surface of the axle box. This is particularly significant because most axle boxes are mounted from above, and thus have lower walls which are not load bearing. As a result the lower walls are often relatively thin, and can be substantially weakened as a result of such machining. Furthermore, it is also necessary to find a means of restraining the sleeve against movement in the direction of the longitudinal axis of the axle during use.

The present invention has arisen from attempts to overcome the difficulties of the prior art and seeks to provide a low cost method and apparatus by which the axle box can be re-furbished.

Summary of the Invention

According to the invention there is provided an outer race support sleeve for supporting the outer race of a ball- or roller-bearing within a bearing housing defining an inner cylindrical bearing surface, wherein the support sleeve is annular and defines first and second circular edges, is dimensioned so that its width, measured between the first and second circular edges, is substantially equal to or not substantially greater than the width of the outer race with which the support sleeve is adapted to be used, and is split from the first circular edge to the second circular edge so as to define two adjacent end portions of the support sleeve, the split allowing the support sleeve to be resiliently compressed, in use, so that said two adjacent end portions overlap one another in order to reduce the effective diameter of the support sleeve, thus allowing the support sleeve to be inserted into the bearing housing.

The support sleeve described above provides a number of important advantages when used in a method, to be described below, which involves machining an annular groove in the bearing surface of the bearing housing at a location corresponding to that of the ball- or roller-bearing in use, and fitting the support sleeve into said annular groove. Firstly, because the support sleeve is of comparable width to the outer race, it is only necessary to machine an annular groove of this width, rather than to machine the entire length of the bearing surface of the bearing housing. This not only ensures that the process is quicker and simpler to carry out, but also ensures that the bearing housing is not unnecessarily weakened as a result of machining away metal along the entire length of the bearing surface. Furthermore, because the support sleeve is located within an annular groove, the support sleeve is restrained from moving axially within the bearing housing.

Preferably, the support sleeve has a thickness, measured from its inside surface to its outside surface, of less than 2 mm, and most preferably of about 1.6 mm.

The advantage of using such a thin support sleeve is that it can be used with bearing housings having particularly thin walls.

In a preferred embodiment of the invention, the support sleeve is formed from spheroidal graphite iron, which is more flexible than one formed from cast iron.

Advantageously, the said split extends along a substantially straight line between the first and second circular edges of the support sleeve.

This feature can produce the advantage of ensuring that the support sleeve locates firmly within the groove which is machined into the inner surface of the bearing housing. The reason for this is that, if the material of the support sleeve contains internal stresses, the provision of a straight split allows said two adjacent end portions of the support sleeve to move slightly sideways (i.e. in the axial direction of the cylindrical sleeve) in opposite directions, so that the first and second circular edges of the support sleeve effectively grip the edges of the groove, thus preventing rotation of the support sleeve when the axle is rotated.

Conveniently, the split is diagonal, so as to travel around a portion of the circumference of the support sleeve as it passes from the first circular edge to the second circular edge.

The invention also provides a bearing assembly comprising a bearing housing defining an inner cylindrical bearing surface, a bearing having a plurality of rotatable members held between inner and outer races, the bearing being located, in use, between said inner cylindrical bearing surface and the outer surface of an axle passing through the bearing housing, and an outer race support sleeve as described above for supporting the outer race within the bearing housing, wherein the inner cylindrical bearing surface is provided with an annular groove adapted to receive the outer race support sleeve, and said annular groove has a width which is substantially equal to, or not substantially greater than, the width of the outer race.

The bearing assembly can comprise two or more outer race support sleeves, each having the features described above, together with associated bearings, spaced along at least a portion of the length of the axle, each support sleeve being received within a respective annular groove, and being adapted to support a respective outer race.

The invention also provides a method of prolonging the life of a bearing housing having an inner cylindrical bearing surface defining an axle cavity adapted to receive an axle, and a bearing located between the axle and the inner cylindrical bearing surface, said bearing being provided with inner and outer races and rotatable members located therebetween, the method comprising the steps of removing the axle and the bearing from the axle cavity, machining, at a location corresponding to the position of

the bearing when fitted within the axle cavity, an annular groove, of width substantially equal to or not substantially greater than, the width of said outer race, in the inner cylindrical bearing surface, resiliently compressing an outer race support sleeve as described above, passing the outer race support sleeve into the axle cavity, releasing the outer race support sleeve so that the support sleeve expands and fits into the annular groove, and replacing the axle and bearing within the axle cavity so that the outer race is supported by the outer race support sleeve.

Of course, if the bearing housing has more than one bearing, a separate support sleeve can be used for each bearing.

In one embodiment, the annular groove is machined to a depth which is less than the thickness of the outer race support sleeve, and the method includes, after fitting the support sleeve into the annular groove, machining the inner surface of the support sleeve until it is substantially flush with said inner cylindrical bearing surface.

The method can include the step of gluing the outer race support sleeve into said annular groove prior to replacing the axle and bearing within the axle cavity.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings.

Brief Description of Drawings

Fig. 1 is a longitudinal cross-sectional view through a bearing assembly having two roller-bearing, and being fitted with two outer race support sleeves; and

Fig. 2 is a perspective view of one of the outer race support sleeves of Fig. 1.

Detailed Description of Preferred Embodiment

Referring to Fig. 1, the bearing assembly 1 encloses an outer end 2 of an axle 4 of a railway carriage, the axle having an outer cylindrical bearing surface 14. The bearing assembly comprises a bearing housing or axle box 6 which has an inner cylindrical bearing surface 8 defining an axle cavity 9, and inner and outer roller-bearings 10 and 12 located between an outer cylindrical surface 14 of the axle 4 and the inner cylindrical bearing surface 8. Each roller-bearing 10, 12 is provided with inner and outer races 16 and 18 respectively, between which are held a plurality of rollers 20.

In use, the axle box is supported from its upper side 22. As a result of this, the lower wall 24 of the axle box is relatively thin, typically 6 mm to 1 cm, since it is not load bearing. The inner races 16 are tightly fitted to the outer surface 14 of the axle 4, and thus always rotate with the axle 4. The outer races 18, on the other hand, are relatively loosely fitted within the inner cylindrical bearing surface 8, so that they can very slowly rotate in the direction of rotation of the axle 4 if necessary. Over a period of time, this rotation of the outer races 18 causes annular grooves to be worn in the inner cylindrical bearing surface 8.

Fig. 2 shows an outer race support sleeve 26 which can be used to overcome the problem of wear to the inner cylindrical bearing surface 8. The support sleeve 26 is formed from an annular strip of spheroidal graphite iron, and defines first and second circular edges 28 and 30. The support sleeve 26 has a diameter of about 22 cm, and a width, measured between the first and second circular edges 28 and 30, of about 7 cm.

A diagonal split 32 extends between the first and second circular edges 28 and 30, so as to provide the support sleeve 26 with two adjacent end portions 34. As shown in Fig. 2, stresses within the support sleeve 26 cause the two adjacent end portions 34 to move slightly sideways in opposite directions.

When the inner cylindrical bearing surface 8 has worn to an extent which is no longer acceptable, the axle 4 and inner and outer roller-bearings 10 and 12 are removed from the axle cavity 9, and two annular grooves 36 are machined into the inner cylindrical bearing surface 8 at locations corresponding to the positions of the inner and outer roller-bearings 10 and 12 when the axle box is in use. A respective support sleeve 26 is then inserted into each annular groove 36. In order to do this, each support sleeve 26 must first be compressed so that its end portions 34 overlap. It will be appreciated that each support sleeve 26 need only be compressed to the degree required for it to be inserted into the axle cavity 9. When the support sleeves 26 have been inserted to the required locations within the axle cavity 9, they are released and resiliently expanded into the annular grooves 36. If necessary, the support sleeves 26 can be glued within their respective annular grooves 36 with metal adhesives such as those sold under the registered trade mark LOCTITE.

In any case, the first and second circular edges 28 and 30 of each support sleeve 26 grip the side walls 38 of the annular grooves 36 as a result of the tendency of the two end portions 34 to move sideways in opposite directions due to the stresses within the material of the support sleeve 26.

The width of the two support sleeves 26, the width of the two annular grooves 36, and the width of the inner and outer roller-bearings 10 and 12 are all substantially the same. The annular grooves 36 are cut to a depth of about 1.6 mm, and the thickness of the support sleeves 26 is about 3 mm. Therefore, after installation of the support sleeve 26 within the annular grooves 36, it is necessary to machine the inside surfaces of the support sleeves down to the same level as the rest of the bearing surface 8. The final thickness of the support sleeves 26 is, therefore, about 1.6 mm.

Alternatively, the support sleeve 26 can be made to a thickness of 1.6 mm, in which case no machining of the inside surface of the support sleeve 26 is required.

Once the axle box 6 is fitted with the support sleeves 26, the axle 4 and roller-bearings 10 and 12 can be reinserted into the axle cavity 9, and the axle box 6 can be used as normal. It will be seen that use of the support sleeves 26 ensures that the axle box 6 does not need to be discarded when worn. Furthermore, the process described

above is considerably simpler and cheaper to carry out than the methods which have been proposed in the past.

The foregoing describes only one embodiment of the present invention and modifications obvious to those skilled in the art can be made thereto without departing from the scope of the present invention. For example, the sleeves 26 can be slightly wider or slightly more narrow than the width of the other race. Other types of bearings can also be used.

CLAIMS

1. An outer race support sleeve for supporting the outer race of a ball- or roller-bearing within a bearing housing defining an inner cylindrical bearing surface, wherein the support sleeve is annular and defines first and second circular edges, is dimensioned so that its width, measured between the first and second circular edges, is substantially equal to or not substantially greater than the width of the outer race with which the support sleeve is adapted to be used, and is split from the first circular edge to the second circular edge so as to define two adjacent end portions of the support sleeve, the split allowing the support sleeve to be resiliently compressed, in use, so that said two adjacent end portions overlap one another in order to reduce the effective diameter of the support sleeve, thus allowing the support sleeve to be inserted into the bearing housing.

2. An outer race support sleeve as claimed in Claim 1, which has a thickness, measured from its inside surface to its outside surface, of less than 2 mm.

3. An outer race support sleeve as claimed in Claim 2, which has a thickness, measured from its inside surface to its outside surface, of about 1.6 mm.

4. An outer race support sleeve as claimed in any preceding claim, which is formed from spheroidal graphite iron.

5. An outer race support sleeve as claimed in any preceding claim, wherein said split extends along a substantially straight line between the first and second circular edges of the support sleeve.

6. An outer race support sleeve as claimed in Claim 5, wherein the material of the support sleeve contains internal stresses which cause said two adjacent end portions of the support sleeve to move in the axial direction of the cylindrical sleeve in opposite directions, so that the first and second circular edges of the support sleeve effectively grip the edges of the groove, thus preventing rotation of the support sleeve when the axle is rotated.

7. An outer race support sleeve as claimed in any preceding claim, wherein said split is diagonal, so as to travel around a portion of the circumference of the support sleeve as it passes from the first circular edge to the second circular edge.

8. A bearing assembly comprising an outer race support sleeve as claimed in any preceding claim, a bearing housing defining an inner cylindrical bearing surface, and a bearing having a plurality of rotatable members held between inner and outer races, the bearing being located, in use, between said inner cylindrical bearing surface and the outer surface of an axle passing through the bearing housing, the outer race support sleeve supporting the outer race within the bearing housing, wherein the inner cylindrical bearing surface is provided with an annular groove adapted to receive the outer race support sleeve, and said annular groove has a width which is substantially equal to, or not substantially greater than, the width of the outer race.

9. A bearing assembly as claimed in Claim 8, which comprises two or more such outer race support sleeves together with associated bearings, spaced along at least a portion of the length of the axle, each support sleeve being received within a respective annular groove, and being adapted to support a respective outer race.

10. A method of prolonging the life of a bearing housing having an inner cylindrical bearing surface defining an axle cavity adapted to receive an axle, and a bearing located between the axle and the inner cylindrical bearing surface, said bearing being provided with inner and outer races and rotatable members located therebetween, the method comprising the steps of removing the axle and the bearing from the axle cavity, machining, at a location corresponding to the position of the bearing when fitted within the axle cavity, an annular groove, of width substantially equal to or not substantially greater than, the width of said outer race, in the inner cylindrical bearing surface, resiliently compressing an outer race support sleeve as described above, passing the outer race support sleeve into the axle cavity, releasing the outer race support sleeve so that the support sleeve expands and fits into the annular groove, and replacing the axle and bearing within the axle cavity so that the outer race is supported by the outer race support sleeve.

11. A method as claimed in Claim 9, wherein the bearing housing has more than one bearing, and a separate support sleeve is used for each bearing.

12. A method as claimed in Claim 9 or 10, wherein the annular groove is machined to a depth which is less than the thickness of the outer race support sleeve, and the method includes, after fitting the support sleeve into the annular groove, machining the inner surface of the support sleeve until it is substantially flush with said inner cylindrical bearing surface.

13. A method as claimed in any one of Claims 9 to 11, which further includes the step of gluing the outer race support sleeve into said annular groove prior to replacing the axle and bearing within the axle cavity.

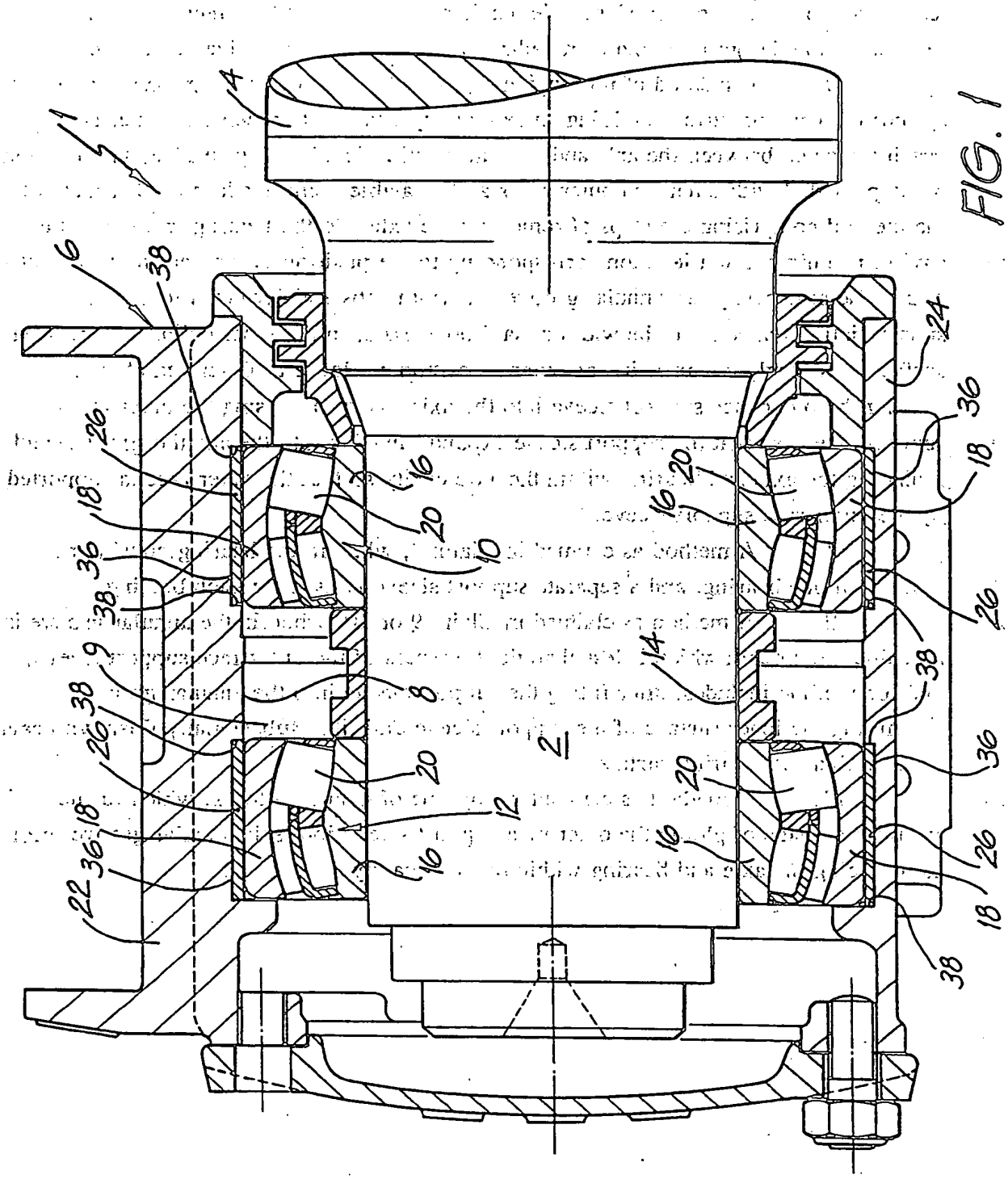

FIG. 1

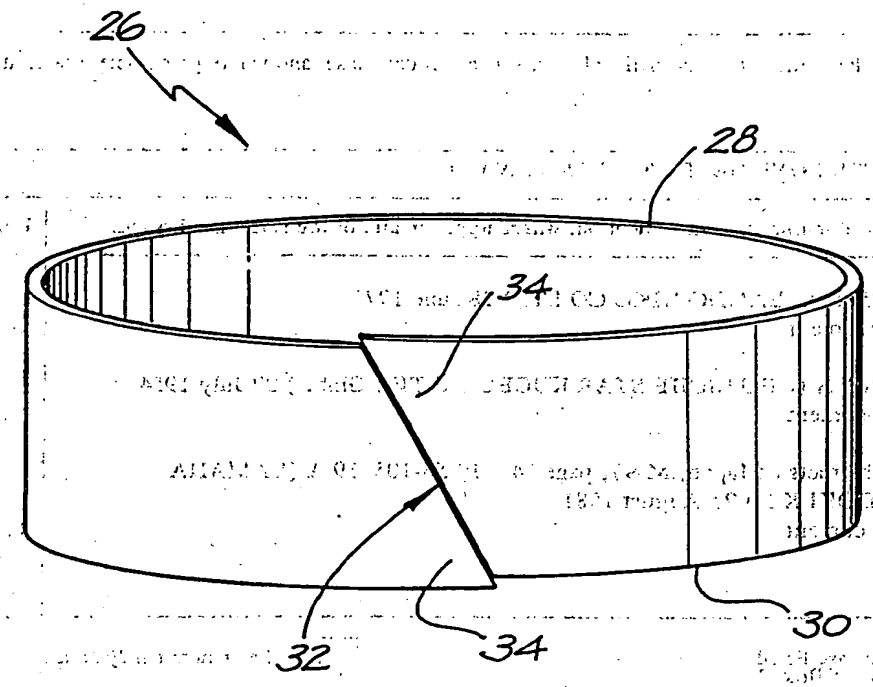

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 95/00091

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl.[6] F16C 35/077

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC F16C 35/077, 35/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	GB 1279516 A (BANDO KIKO CO LTD) 28 June 1972 whole document	1-5,7
X	DE 915401 A (DEUTSCHE STAR KUGELHALTER GmbH) 22 July 1954 whole document	1,5
X	Patent Abstracts of Japan, M-97, page 143, JP 56-105119 A (YAMAHA HATSUDOKI K K) 21 August 1981 whole document	1,7

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 April 1995	24 MAY 1995 (24.05.95)
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. 06 2853929	Authorized officer KURT TOBLER Telephone No. (06) 2832469

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
A	EP 164447 A (SIEMENS AG) 18 December 1985 whole document	
A	US 3533667 A (KUGELFISCHER) 13 October 1970 whole document	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 95/00091

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member					
GB 1279516	CH	532731	DE	2041948	FR	2065887
	US	3672734	BE	758590		

END OF ANNEX

Patent Abstracts of Japan

PUBLICATION NUMBER : 60081518
PUBLICATION DATE : 09-05-85

APPLICATION DATE : 13-10-83
APPLICATION NUMBER : 58189890

APPLICANT : TANIGUCHI MASANORI;

INVENTOR : TANIGUCHI MASANORI;

INT.CL. : F16C 43/04

TITLE : RECLAIMING AND PROCESSING METHOD OF BEARING

ABSTRACT : PURPOSE: To contrive effective use of a bearing, by a method wherein the bearing is disassembled, and an inner and outer races and a rolling element having no damage and predetermined dimensional accuracy are assembled by uniting and adjusting them after their selection and cleaning.

CONSTITUTION: A bearing which has become unserviceable is recovered and disassembled into an inner and outer races and a rolling element respectively. After disassembly, parts having no damage and predetermined dimensional accuracy are selected through inspection and cleaned. Then necessary gap accuracy and rotation accuracy are adjusted for assembly by combining appropriately those inner and outer races and rolling element so as to coincide with any of necessary standard out of various kinds of predetermined standards corresponding to use purpose in a new bearing.